[Second Edition.]

PATENT SPECIFICATION

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COMPLETE SPECIFICATION.

Improvements in Steam Boiler Furnaces.

I, THEODOR LANGER, of XIX, Sieveringerstrasse 36, Vienna, Austria, Engineer, a citizen of the Republic of Austria, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

Furnaces are already known in which, for preventing the formation of smoke, steam-jets somewhat in the shape of a fan are directed over the fuel so as to come into contact with the wall opposite the fire-door (the tube plate in the case of locomotives) or with the side wall. At these places the said steam-jets prevent the rising of heating gases and facilitate the combustion of the same by means of the overgrate blast supplied to the steam-jets. The steam-jets also prevent rising of the heating gases or the direct heating of the walls with which they come into contact and thus reduce the air-passage or process of combustion at the parts of the grate adjacent to these walls. A zone of a particularly high temperature remains in the fire-box below these steam-jets so that the fuel disposed further down is transformed into clinker. Further it is already known to pass steam over the entire length and width of the grate through perforated hollow members located above the fire-door, in order to produce water-gas and burn the same in the fire-box. The steam-jets thus hinder the passage of air through the entire grate.

The present invention has for its object an improved method of applying the steam-jets by which it is possible, firstly to render possible the most economical positioning of the fuel in order to utilise more effectively the greater part of the fuel disposed near the walls and to simplify and facilitate stoking; and secondly to pass over and force against all the heating surfaces the generated heating gases and force the latter to travel a long way through the fire-box during which travel the heating gases are burned practically completely and smokelessly and give up their heat before reaching the heating channels or fire-tubes; and thirdly the formation of a hot zone in the fire-box, which transforms the fuel into clinker, is rendered impossible.

The heating gases produced in the part of the grate-area which is in the shape of a triangle (the base of which is adjacent to the tube-plate and extends practically over the entire width and the sides of which are inclined symmetrically with respect to the longitudinal middle and terminate near the door wall) are badly utilised because the greater part of the said gases pass out of the fire-box without coming into contact with the side walls and door-wall which act as cooling means.

By the present invention this disadvantage is overcome because the air-draught is reduced in the insufficiently used middle part of the grate while the heating gases, produced at the other parts of the grate, which parts are disposed nearer to the walls, are brought more efficiently into contact with the walls so that owing to the reduced combustion in the middle portion of the grate-area the reduced fuel consumption results in a saving of fuel.

According to the present invention a steam-distributing device is provided which is furnished with nozzle-shaped openings which are arranged in such a manner that their lines of direction uniformly diverge from the top and laterally and do not intersect each other, so that they meet the fuel-surface in a plane extending from one corner to the other corner of the tube-plate (opposite wall in case of ordinary boilers and grate-area in the case of a boiler with a number of doors) and are gradually reduced towards

the middle of the furnace-door and terminate between the tube-plate and door-wall, the nozzle-shaped openings in the steam-distributing device being distributed over a surface which is symmetrically reduced towards the bottom of the said device. Further, the steam chest is provided with a fitment in communication with the casing through which steam is supplied to the steam distributor, the said fitment being provided with a passage which admits of more than the quantity of steam required for cooling the steam distributor passing to the said casing which is provided with a restricted passage in order to permit at all times of a minimum supply of steam to the steam distributor so as to prevent overheating thereof.

In order that the invention may be clearly understood and readily carried into effect, reference is made to the accompanying drawings in which:—

Figure 1 is a vertical section through the fire-box.

Figure 2 is a sectional plan shewing the distribution of the steam-jets over the grate-area in a boiler having one door.

Figure 3 is a sectional plan shewing the distribution of the steam-jets over the grate-area in a boiler having two doors.

Figures 4 and 5 shew a view of the steam-distributor with different arrangements of perforations.

Figure 6 shews in section a fitment for attachment to the outer end of the steam-distributor-pipe.

Figure 7 shews a vertical longitudinal section through the furnace and also the arrangement for the distribution of the steam.

Figure 8 shews a detail relating to the cooling of the steam-distributor.

Figure 9 shews a detail relating to the feed for the steam-distributor.

Figure 10 shews a detail relating to a guide plate.

Figure 11 shews a further constructional form of the steam-distributor.

According to the invention a steam-distributing device D (Figures 1 to 3) of novel construction is arranged inside the fire-box. As shewn in Figures 4 and 5, the steam-discharge-holes of the distributing device are arranged side by side and underneath each other in horizontal rows in such manner that from the top to the bottom row the number of holes in each row is reduced by one hole and the holes of one row are staggered with respect to the holes in the adjacent row or rows; they are preferably disposed centrally of the two holes in the adjacent upper and lower rows. Thus the connecting lines of the outside holes form a triangle (Figure 4) or a trapezium (Figure 5) the horizontal base lines of the triangle and trapezium being disposed at the top while the apex and the lower and shorter side of the trapezium are situated at the bottom.

As shewn in Figures 1 to 3, the lines of direction of the jets from the nozzle-shaped holes in D diverge uniformly downwardly as well as laterally and do not intersect each other. The jets 1 and 3 (Figure 2) or 1, 3, 7 and likewise the jets 1 and 9 (Figure 3) are directed approximately towards the corners of the tube-plate or towards the corners of the grate-area (in case of fire-chambers having a number of doors), the lowest jets 6 (Figure 2) or 6 and 12 (Figure 3) passing into the middle of the grate between the tube-plate and door-wall. Therefore the lines of direction of the nozzle-shaped holes meet the fuel at areas which taper off symmetrically from the tube-plate towards the middle of the door-opening. In order to attain this object it is essential that the grate-area over which the steam is distributed should correspond more or less in shape (see Figures 2 and 3) to that of the area over which the steam is distributed.

The steam-distributing device D is attached to a steam-pipe 15 (Figure 7) which, in the construction illustrated is in communication with a casing 18 (Figures 1 and 7) disposed at the outside above the fire-door opening. As shewn in Figure 8 three steam-pipes are attached to or branch-off the casing 18 in order to discharge steam into the steam-distributing device, the pipe 21 being in communication with the steam-chest of the locomotive. The pipe 20 leads from the auxiliary blower of the locomotive and a pipe 17 from the steam-chest of the steam boiler. Non-return valves 18 and 19 (Figure 8) are arranged in the casing 18 behind the inlet openings to the pipes 20 and 21, so that steam cannot pass from the steam-chest into the auxiliary blower or *vice versa*. The valve-balls rest on conically shaped valve seats and the bores of the valves form the valve-chambers while the screw-plugs 22 and 23 of the valve-casing also forms and act as adjustable means for limiting the lift of the valve-balls. In order to maintain a minimum supply of steam so that the steam-distributing device cannot burn out in case the regulator of the locomotive or of the auxiliary blower is in the open position, the downward motion of the adjustable screw-plugs is limited for instance by nuts 24, 25 on the said plugs 22, and 23 or by shouldered parts as

shewn on the said plugs so that a minimum lift of the balls is ensured.

The arrangement according to the present invention operates in the following manner: —

When the regulator of the locomotive or the auxiliary blower is open, steam passes automatically to the steam-distributing device and the outflowing steam-jets form a steam-body substantially in the shape of a three-sided pyramid, whose substantially three-sided base is disposed above the middle of the grate as indicated in dotted lines in Figures 2 and 3. The corner or outside jets are slightly drawn inwardly by the inner jets. The diameters of the holes in D is such and the steam supply to the steam-distributing device is regulated by the adjustable screw-plugs 22 and 23 (Figure 3) in such manner that the steam-body, before reaching the fuel, is held suspended by the gaseous current rising therefrom, so that the gases generated underneath the steam-body together with the fatigued or divided steam may pass out towards the walls at all sides underneath the steam-body. The pyramidal steam-body suspended above the fuel retains, of course, in its core, the greatest force, and the air-current around it is gradually increased mainly towards the side walls and the door-wall. As the height of the fuel has to be adapted to the extent of the air-draught at the corresponding place of the grate, the deflection of the air-draught requires an arrangement of the fuel which, as shewn in Figure 1, is reduced in height in the longitudinal direction from the door-wall towards the tube-plate and is in the shape of a wedge and in the shape of a trough from the side walls and the door-wall towards the middle of the grate, which trough increases in depth towards the tube-plate. Owing therefore to this arrangement of fuel it is necessary only to stoke the fuel along the side walls and the door-wall and at the latter place in a correspondingly increased quantity, whereafter the fuel rolling off from the walls towards the middle of the grate is evenly distributed over the slopes. On closure of the locomotive regulator the generation of steam-body stops. The draught to the fire-grate (under-draught) then flows by the path of least resistance, that is to say, through the middle of the grate because in this position the packed coal layer is thinnest whilst at the more important position for the production of steam, namely, on the side walls of the fire-box, the burning layer is packed much higher by the packing or aggregation of the coal layer above the grate and therefore in this position the under-draught cannot pass through. The fire therefore at this position is not spent and the burning layer does not increase at this position or only slightly. The burning layer on the side walls on long standing of the locomotive, does not increase accordingly and does not develop a high temperature so that an increase of the boiler pressure and blow off of the boiler safety valve is avoided.

In consequence of this arrangement of the fuel, necessitated by the suspended pyramidal steam-body, the greatest part of the fuel burns near the side-wall and near the door-wall where it is more efficiently utilised while, in the triangular surface in the longitudinal middle of the grate (illustrated in Figure 2) not much fuel is burnt near the tube-plate because as that place the same cannot be utilised as efficiently.

All the aforesaid advantages can only be obtained if the direction-lines 1, 2 and 3 to 12 from the perforated nozzle of the steam-distributor D are arranged as shewn in Figures 2 and 3 so as to meet the layer of burning material over a plane surface which extends from corner to corner of the tube-plate 1 and 3, Figure 2, in a single-door boiler, or an area extending from corner to corner of the grate bars 1, 3, 7, 9 (Figure 3) in a multi-door boiler and if the said lines in both cases constantly converge towards the middle of the door and terminate between the door-wall and tube-plate, and also if the perforations in the nozzle of the steam-distributor are arranged as in Figures 4 and 5.

The present invention is not limited to locomotive boilers only, but may be applied to any kind of steam-boiler furnaces.

It may be necessary to increase the combustion, *e.g.* to still further increase the boiler-output. In order to attain this object a supplementary group of one or more than one nozzle-hole is arranged in the steam-distributing device as in Figure 11 wherein two additional holes 46^1, 47^1 are shewn, whose lines of direction, as 46 and 47 in Figure 1, are directed towards the discharge of the heating gases from the furnace, for example, over the fire-arch (or fire-bridge in stationary boilers. The generated supplementary steam-body drives the gases in front of it and increases the effect of the air-draught.

The full effect of a steam-distributing device arranged in the furnace is possible only if the central plane of the generated steam-body is disposed exactly vertical and is directed exactly against the

middle of the tube-plate so that the heating gases rise uniformly distributed at both sides of the generated steam-body. The exact adjustment of the steam-distributing device is effected by the following new arrangement which is shewn in Figure 7.

A pipe 14, in the construction illustrated in the shape of a hollow staybolt, passes through the boiler-wall above the top of the door-opening. An elbow tube 15 is rotatably mounted and also adapted to be fixed to this pipe, the outside end of the said tube 15 being secured to the casing 13 which is connected to the steam-supply-pipes by means of a cup-shaped nut 16. The branch of the elbow tubes extending into the interior of the furnace, is directed towards the grate and is of a length necessary for the height at which the steam-distributing device is situated. The steam-distributing device is screwed to the end of the elbow tube. In order to exactly adjust the steam-distributing device in the horizontal and vertical directions, the elbow tube is composed of two branch-pipes 15 and 32, which are screwed to a quarter bend 30 and thus are rotatable and can be fixed in the adjusted position by means of nuts 31. The elbow tube can be removed or pulled out from the inside by removing the cup-shaped nut 16. A set-screw 27 arranged at the outside and adapted to engage in a recess in the elbow tube always secures the latter in the same position. The elbow tube 15 may be in one piece in which case an adjusting collar 26 is arranged at the outside on the hollow staybolt and is preferably fixed by a clamping screw 28. This adjusting collar carries the set-screw 27. In order to correct the position of the distributing device the set-screw 27 is lifted and the adjusting collar is rotated on the hollow staybolt, whereby the set-screw 27 as well as the angular tube are also rotated. The steam-distributing device D can be placed into the proper position on the branch of the elbow tube by loosening the lock-nut 31.

It is of advantage to deflect the in-rushing air in the direction of the steam-body in case the door is open. An easily removable guide plate L of novel construction and illustrated in Figures 7 and 10 serves to attain this object. A double eye 33 is provided at the top side of the guide-plate and at the lower part these eyes are enlarged to such an extent that they can be pushed over the heads 34 of the supporting screw which is screwed into the boiler-wall, whereafter the guide-plate is pulled downward and is fixed by the heads of the supporting screws which engage with wedge-shaped strips 41 arranged at the side of the openings.

Figure 9 shews a general arrangement of means which serve to cool the steam distributing device D, only a very small quantity of steam being necessary to effect this object. The details of the necessary parts of Figure 9 are shewn in Figures 6 and 8. The casing 13 hereinbefore described is connected to the steam chest 34 by means of a fitting 35 as, for example, by means of a pipe 17. The fitting 35 is provided with a passage 36 and the casing 13 is provided with intercommunicating passages 38 and 39, the passage 39 being considerably larger than the passage 39. In the interior of the fitting 35 is a depositing chamber 44 with which the passage 36 communicates, the said chamber being closable by means of a cap-nut 37 which can be removed from time to time for cleaning purposes. The steam required for cooling purposes passes from the steam chest 34 through the passage 36 and into the depositing chamber 44 and from thence through the pipe 17 to the casing 13 and through the passage 38 therein and from thence through the passage 39, openings 42, tube 15, bend 30 and tube 32 to the steam distributing device D. The passage 39 for the entry of the cooling steam into the casing 13 cannot become choked and permits at all times of a minimum supply of cooling steam to the steam distributing device D so as to prevent overheating thereof. In Figure 9, 45 is the furnace door, 46 is the boiler shell and 47 a handle for operating the furnace door.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. In a steam-boiler-furnace in which steam-jets are blown from the top of the door opening onto the fuel, the provision of a steam-distributing device furnished with nozzle-shaped openings which are arranged in such a manner that their lines of direction uniformly diverge from the top and laterally and do not intersect each other, so that they meet the fuel-surface in a plane extending from one corner to the other corner of the tube-plate (opposite wall in case of ordinary boilers and grate-area in the case of a boiler with a number of doors) and are gradually reduced towards the middle of the furnace-door and terminate between the tube-plate and door-wall, the nozzle-shaped openings in the steam-distributing device being distributed over a sur-

face which is symmetrically reduced towards the bottom of the said device.

2. A steam-boiler-furnace as claimed in Claim 1 in which the nozzle-shaped openings in the steam-distributing device are disposed in horizontal rows and from the top to the bottom the number of openings in each row is reduced by one hole, the openings of the one row being staggered with respect to the openings in the adjacent upper and lower rows and are so directed that the lines of direction of the top row meet the fuel surface near the tube-plate (opposite wall) and the lines of direction of the bottom row between the tube-plate and the door-wall.

3. A steam-boiler-furnace as claimed in Claim 2 in which the outer nozzle-shaped openings of the steam-distributing device are arranged according to an inverted isosceles triangle having the base horizontal.

4. A steam-boiler-furnace as claimed in Claims 1 to 3, wherein a supplementary group of one or more than one nozzle-shaped opening is provided above the group of nozzle-shaped openings producing the steam-body, which opening or openings is or are disposed above the first group and whose lines of direction extend in the direction of the outlet of the hot gases or above the fire-arch or fire-bridge.

5. A steam-boiler-furnace in accordance with Claim 1, wherein the steam-distributing device is secured to that branch of an elbow tube which is directed towards the grate, the said tube being rotatably mounted on and also adapted to be fixed in a tubular member passing through the boiler-wall above the opening of the door and at the outside thereof, the said elbow tube being connected to the steam-supply of the steam-distributing device.

6. A steam-boiler-furnace as claimed in Claim 5 in which the branches of the elbow tube are secured to a quarter bend which establishes communication between the said branches.

7. A steam-boiler-furnace as claimed in Claim 5 wherein the tubular member passing through the boiler-wall is provided at the outside with an adjusting collar which can be fixed by means of a clamping-screw and further is furnished with a set-screw for fixing the elbow tube in the tubular member.

8. A steam-boiler-furnace as claimed in Claim 1 wherein the steam-distributing device is in communication with the steam-chest and the auxiliary blower of a locomotive by means of pipe-lines in which valves rest on valve seats, so that the steam can flow only towards the said device and whereby the lift of the valves can be adjusted by regulating screws, the downward movement of which latter is limited to a predetermined minimum.

9. A steam-boiler-furnace as claimed in Claim 1 or in Claims 1 to 6, wherein a guide plate having upwardly extending eyes is provided above the door-opening, the said eyes being pushed over headed screws and having enlarged lower ends to permit the eyes to be pushed over the heads of the said screws, the said heads being clamped in position by means of laterally disposed, downwardly inclined wedge-shaped strips.

10. A steam-boiler-furnace in accordance with Claim 1, wherein the steam chest is provided with a fitment in communication with the casing through which steam is supplied to the steam distributor, the said fitment being provided with a passage which admits of more than the quantity of steam required for cooling the steam distributor passing to the said casing which is provided with a restricted passage in order to permit at all times of a minimum supply of steam to the steam distributor so as to present overheating thereof.

11. A steam-boiler-furnace constructed arranged and adapted to operate substantially as hereinbefore described, with reference to the example illustrated by the accompanying drawing.

Dated this 7th day of October, 1924.

J. S. WITHERS & SPOONER.
Chartered Patent Agents,
Staple House, 51 & 52, Chancery Lane, London,
Agents for the Applicant.

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2nd Edition

Fig. 1

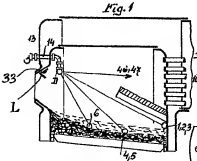


Fig. 2

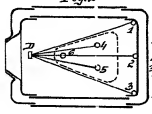


Fig. 3

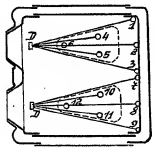


Fig. 4

Fig. 5

Fig. 6

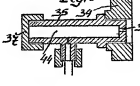


Fig. 8

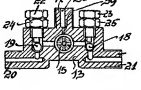


Fig. 7

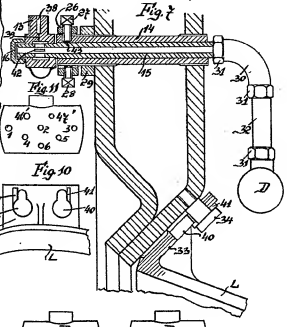
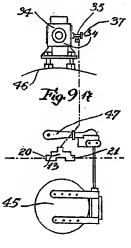


Fig. 11

Fig. 10

Fig. 9



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